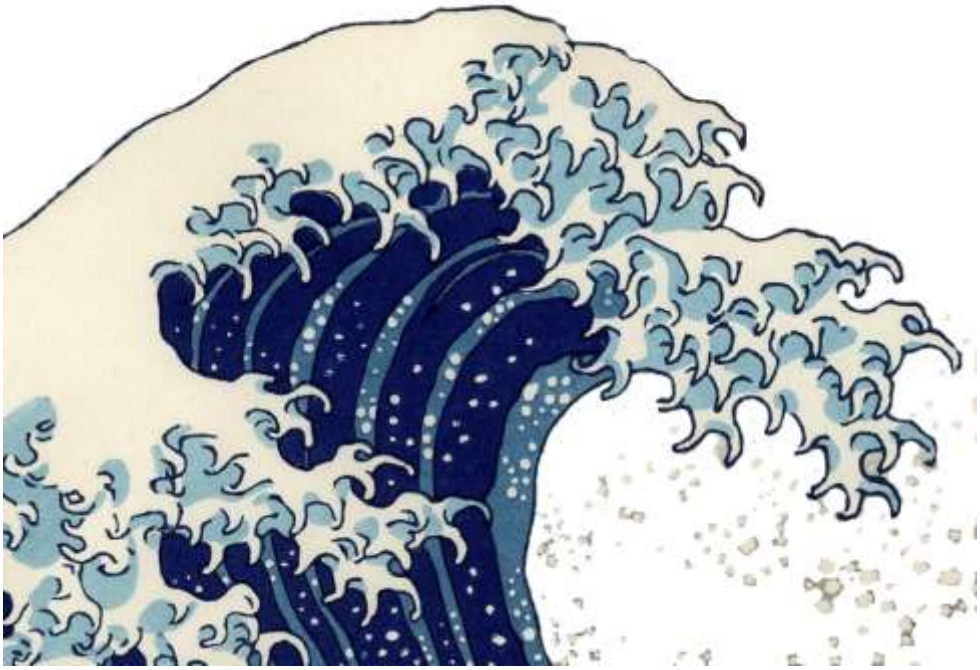
School:_____ Team #: _____

Student names:_____

Crave the Wave



DO NOT OPEN OR START TEST UNTIL TOLD TO DO SO

Instructions:

- Answer all questions on the answer sheet. No answers on the test booklet will be scored.
- When the Event Supervisor indicates time is up, STOP WRITING. Turn in ALL materials. Failure to do either will result in team disqualification.
- Write legibly. If we can't read the answer, it is wrong!
- Sheets may be double sided, check both sides!
- If you separate the sheets of the test, be sure to label **each** sheet with school name and team number in case they get mixed up during scoring.
- When you are called up for the Station questions, stop this test immediately. You may not go back to a station, but may continue to work on any calculations after leaving the station.

1. Waves are disturbances that transport _____ from one location to another without transportation matter.
   a. Atoms
   b. Energy
   c. Frequency
   d. Chert

2. A typical human eye will respond to wavelengths from about ___ nm to ___ nm (round to the nearest 100 nm).
   a. 100, 300
   b. 200, 500
   c. 400, 700
   d. 600, 900

3. Radiation therapy using Gamma Rays is used to kill cancer cells. Hospitals use Gamma Rays rather than X Rays because they are completely safe and have no harmful side effects.
   a. True
   b. False

4. If a ray travels from a medium of lower refractive index into a medium of higher refractive index, it is bent _____ the normal.
   a. Away from
   b. Toward
   c. Along
   d. Perpendicular to

5. The sound from a bolt of lightning is heard 5 seconds after you see the flash. If you have nominal conditions such that the speed of sound is 340 m/s, how far away was the lightning strike (to the nearest tenth of a meter)?

6. Humans cannot see UV light, but our bodies respond to it by _____.

7. Mrs. Brown bought a bottle of pop. She used it to make music by blowing across the top of the bottle. As she drank the pop, the frequency of the sound
   a. Became higher
   b. Became lower
   c. Did not change

8. Mrs. Brown is looking at her reflection in a plane mirror. If she approaches the mirror at a speed of 25 m/s, how fast does she approach her image in the mirror?
   a. 15 m/s
   b. 25 m/s
   c. 12.5 m/s
   d. 50 m/s

9. You have a lot of time between events and notice the swing on the playground at BCS. You decide to have a little fun and hop on the swing with a characteristic motion. You complete a back and forth cycle every 2 seconds. The frequency of your swing is _____.
   a. 0.5 Hz
   b. 1.0 Hz
   c. 2 Hz

10. The _____waves are the waves that cause the most damage during an earthquake. They travel with velocities slower than S waves, and arrive later, but with much greater amplitudes. These are also the waves that are most easily felt during an earthquake and involve both up-down and side-to-side motion.

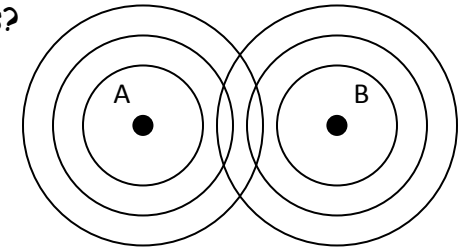
11. According to Dr. Sheldon Cooper, this is the apparent change in the frequency of a wave caused by relative motion between the source of the wave and the observer.

12. The energy transported by a wave is directly proportional to the square of the amplitude of the wave. This energy-amplitude relationship is sometimes expressed in the following manner.

$$E \propto A^2$$

A tripling of the amplitude of a wave is indicative of a _____-fold increase in the amount of energy transported by the wave.

13. The diagram below represents the wave pattern produced when two rocks are tossed into a pond at points A and B. Which phenomenon occurs at the intersections of the circular wave fronts?



a. Diffraction
b. Interference
c. Refraction
d. Reflection

14. What is the frequency of a minute hand on an analog clock (to the nearest hundredth)?

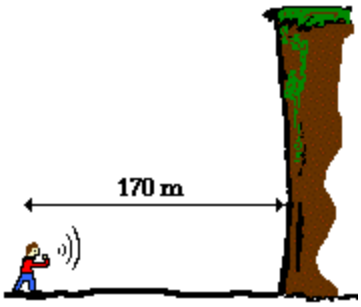
15. Mrs. Brown is treading water (with her head above the water) at the surface of a pool 2m deep. She spies a quarter on the bottom of the pool directly below her feet. Given that apparent depth is equal to the actual depth multiplied by the ratio of the refractive index of the observer to the object,

$$D_{apparent} = D_{actual} * [n_{observer}/n_{object}]$$

a. Is the apparent depth of the coin deeper than the actual depth, the same as the actual depth, or less than the actual depth?
b. If the refractive index of air is 1 and water is 1.33, how deep does the quarter appear to be?

16. True radio broadcasting didn't begin until around 1920, when it sprang up spontaneously among amateur stations. The first method of impressing sound on a radio signal was by _____ the _____, a method still widely used today.

17. Mrs. Brown stands 170 meters away from a steep canyon wall. She shouts and hears the echo of her voice one second later. Based on this information, what is the speed of the wave in m/s?



18. Mrs. Brown hears students running and yelling in the hallway away from her classroom (at 27 m/s – **fast kids**). If the frequency of yelling is **actually** 1000Hz, what frequency will she hear?
    a. 925 Hz
    b. 1000 Hz
    c. 1084 Hz
    d. 2000 Hz

19. If white light strikes a red filter, what color(s) of the ROYGBIV group are transmitted?

20. The colors of peacocks and hummingbirds are the result not of pigments but of ridges in the surface layers of their feathers. By what physical principle do these ridges produce colors?

21. If the path-length difference between two identical and coherent beams is two wavelengths when they arrive on a screen, will they produce a dark or a bright spot? Due to what wave principle?

22. The _____ of a chemical element or chemical compound is the spectrum of frequencies of electromagnetic radiation emitted due to an atom or molecule making a transition from a high energy state to a lower energy state.

23. In physics, _____ shift happens when light or other electromagnetic radiation from an object is increased in wavelength, or shifted to the _____ (same word) end of the spectrum. This is normally interpreted as a direct, physical observation of the expansion of the spatial volume of the observable universe.

24. Compared to Earth, in outer space we can hear
    a. Better, because lack of air causes less loss of sound intensity
    b. Earlier, because lack of air increases sound speed
    c. Nothing, because lack of air inhibits sound propagation
    d. At a higher frequency, because of less gravity

25. Estimate the time it takes for light to get from the Sun to Earth (use a distance of 150,000,000 km) in minutes and seconds (to the nearest 10 seconds).

26. Given $E=hf$, why is a gamma ray more energetic than an x-ray?

27. How can a hydrogen atom, which has only one electron, have so many spectral lines?
    a. The neutron in the nucleus also has an emission spectrum
    b. There are many energy states the electron can occupy when excited
    c. One is always observing more than one atom
    d. Hydrogen is a noble gas which will always have many spectral lines

28. A transverse wave is transporting energy from east to west. The particles of the medium will move_____.
    a. east to west only
    b. both eastward and westward
    c. north to south only
    d. both northward and southward

29. _____ are a type of surface acoustic wave that travel on solids.
    a. Rayleigh waves
    b. Interference waves
    c. Schrödinger waves
    d. Malocha waves

30. List the three primary colors of light.

31. _____ radiation is what we like to describe as heat. We can't see these waves, but we can feel them.

32. An ocean wave has amplitude of 2.5 m. Weather conditions suddenly change such that the wave has amplitude of 5.0 m. The amount of energy transported by the wave is _____.
    a. halved
    b. doubled
    c. quadrupled
    d. remains the same

33. Noise-cancelling headphones are an example of _____. This is a physical phenomenon of wave mechanics).

34. When you hold your fingers down on a guitar string, what happens to the sound?

    a. The amplitude is less (quieter) as the string cannot vibrate as much.
    b. The pitch is higher as the vibrating part of the string is shorter.
    c. The pitch is lower as the vibrations have farther to travel.
    d. The pitch is lower as the vibrating molecules move slower with the interference of your finger.

35. Mrs. Brown and Mr. Emmi stand 8 meters apart and demonstrate the motion of a transverse wave on a slinky. The wave can be described as having a **vertical** distance of 24 cm from a trough to a crest, a frequency of 3.6 Hz, and a **horizontal** distance of 58 cm from a crest to the nearest trough. Determine the amplitude, period (to the nearest **hundredth**), wavelength, and speed (to the nearest **whole cm/s**) of such a wave.

36. The Mexican Wave, so popular at sporting events, is an example of a _____ wave.

a. Torsion
b. Transverse
c. Lateral
d. Longitudinal

Match each term with its definition

37. Frequency	a. Lowest point of a wave
38.Amplitude	b. The time required for one complete cycle in a repeating oscillation to occur. (1/hz)
39.Period	c. Separation of light into colors arranged according to frequency
40.Trough	d. The power per square meter carried by a sound wave, often measured in decibels
41. Crest	e. Equal to one cycle per second. How frequency of waves is measured.
42.Wave Length	f. A series of alternate reinforcements and cancellations produced by the interference of two waves of slightly different frequencies, heard as a throbbing effect in sound waves.
43.Hertz	g. An increase in the measured frequency of light, or other radiation, from an approaching source; called this because of the increase is towards the high end of the color spectrum. Also occurs when an observer approaches the source.
44.Sine Wave	h. A stationary wave pattern formed in a medium when two sets of identical waves pass through the medium in opposite directions.
45.Square Wave	i. The distance between the crest of one wave and the crest of the next wave.
46.Blue Shift	j. A geometric waveform that appears as a series of squares. It is the sum of odd-numbered harmonics of a pure tone or signal; harmonics: 1, 3, 5, 7.
47.Beats	k. The response of a body when a forcing frequency matches its natural frequency.
48.Critical Angle	l. The minimum angle of incidence inside a medium at which a light ray is totally reflected.
49.Excitation	m. In any periodic motion, the number of complete oscillations measured in hertz. (hz)
50.Intensity	n. Highest point of a wave .
51. Resonance	o. One in which amplitude varies in proportion to the sine function of an angle.
52.Standing Wave	p. The process of boosting one or more electrons in an atom or molecule from a lower to a higher energy level.
53.Dispersion	q. For a wave or vibration, the maximum displacement on either side of the equilibrium (midpoint) position.